SAMSUNG ELECTRONICS

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LEAD FREE

TO :

DATE : May. 15. 2008

*SAMSUNG TFT-LCD*

# MODEL NO. : LTN154CT02-0

NOTE : Extension code [ -0 ]
→ LTN154CT02-**0**
Surface type [ **Anti-Glare** ]

**The information described in this SPEC is preliminary and can be changed without prior notice**

APPROVED BY : K. H. Shin

PREPARED BY : **Application Engineering Part (Mobile)**

**SAMSUNG ELECTRONICS CO., LTD.**

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# REVISION HISTORY

Approval

| Date | Revision No. | Page | Summary |
|---|---|---|---|
| Oct. 19. 2007 | P00 | All | LTN154CT02-0 model Preliminary spec was issued first. |
| Jan. 25. 2008 | P01 | 26 | Panel Rev. Code scheme was added |
| Mar. 31. 2008 | P02 | 7 | Color coordinate of R, G, B were updated |
| May. 15. 2008 | A00 | All | Approval spec was issued |

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## GENERAL DESCRIPTION

### DESCRIPTION

LTN154CT02-0 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight unit. The resolution of a 15.4" contains 1920 x 1200 pixels and can display up to 262,144 colors. 6 O'clock direction is the optimum viewing angle.

### FEATURES

- High contrast ratio, high aperture structure
- 1920 x 1200 pixels resolution (16:10)
- High Color Gamut (Typical 72%)
- Low power consumption
- Fast Response
- 2 CCFL(Y-stack)
- DE(Data enable) only mode
- 3.3V LVDS Interface
- Onboard EEDID chip
- RoHS Compliance
- Windows Vista Premium Logo compliance

### APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC

## GENERAL INFORMATION

| Item | Specification | Unit | Note |
|---|---|---|---|
| Display area | 331.2(H) x 207.0(V) ( 15.4" diagonal ) | mm | |
| Driver element | a-Si TFT active matrix | | |
| Display colors | 262,144 | | |
| Number of pixel | 1920 x 1200 (WUXGA) | pixel | 16 : 10 |
| Pixel arrangement | RGB vertical stripe | | |
| Pixel pitch | 0.1725(H) x 0.1725(V) | mm | |
| Display Mode | Normally white | | |
| Surface treatment | Haze 40, Hardness 3H | | Anti-glare |

Mechanical Information

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module size | Horizontal (H) | 343.5 | 344.0 | 344.5 | mm | |
| | Vertical (V) | 224.5 | 225.0 | 225.5 | mm | |
| | Depth (D) | - | - | 7.0 | mm | (1) |
| Weight | | - | - | 650 | g | |

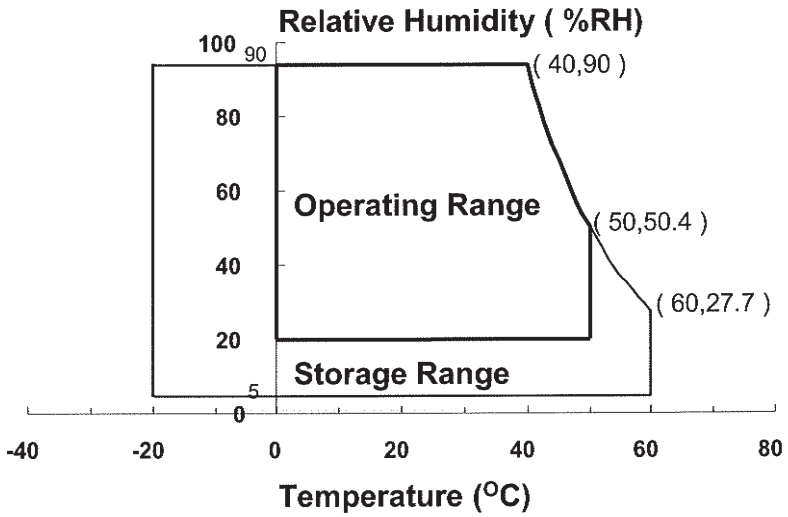
Note (1) Measurement condition of outline dimension
. Equipment : Vernier Calipers
. Push Force : 500g ·f (minimum)

# 1. ABSOLUTE MAXIMUM RATINGS

## 1.1 ENVIRONMENTAL ABSOLUTE RATINGS

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Storage temperate | TSTG | -20 | 60 | °C | (1),(5) |
| Operating temperate (Temperature of glass surface) | TOPR | 0 | 50 | °C | (1),(5) |
| Shock ( non-operating ) | Snop | - | 240 | G | (2),(4) |
| Vibration (non-operating) | Vnop | - | 2.41 | G | (3),(4) |

Note (1) Temperature and relative humidity range are shown in the figure below.
95 % RH Max. (40 °C ≥ Ta)
Maximum wet - bulb temperature at 39 °C or less. (Ta > 40 °C ) No condensation




(2) 2ms, half sine wave, one time for ±X, ±Y, ± Z.
(3) 5 - 500 Hz, random vibration, 30min for X, Y, Z.
(4) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.
(5) If product is used for extended time excessively or exposed to high temperatures for extended time, there is a possibility of wide viewing angle film damage which could affect visual characteristics.

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## 1.2 ELECTRICAL ABSOLUTE RATINGS

### (1) TFT LCD MODULE

$V_{DD}$ =3.3V, $V_{SS}$ = GND = 0V

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Power Supply Voltage | $V_{DD}$ | $V_{DD}$ - 0.3 | $V_{DD}$ + 0.3 | V | (1) |
| Logic Input Voltage | $V_{IN}$ | $V_{DD}$ - 0.3 | $V_{DD}$ + 0.3 | V | (1) |

Note (1) Within Ta (25 ± 2 °C )

### (2) BACK-LIGHT UNIT

Ta = 25 ± 2 °C

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Lamp Current | $I_L$ | 2.0 | 7.0 | mArms | (1) |
| Lamp frequency | $F_L$ | 40 | 80 | kHz | (1) |

Note 1) Permanent damage to the device may occur if maximum values are exceeded
Functional operation should be restricted to the conditions described under normal operating conditions.

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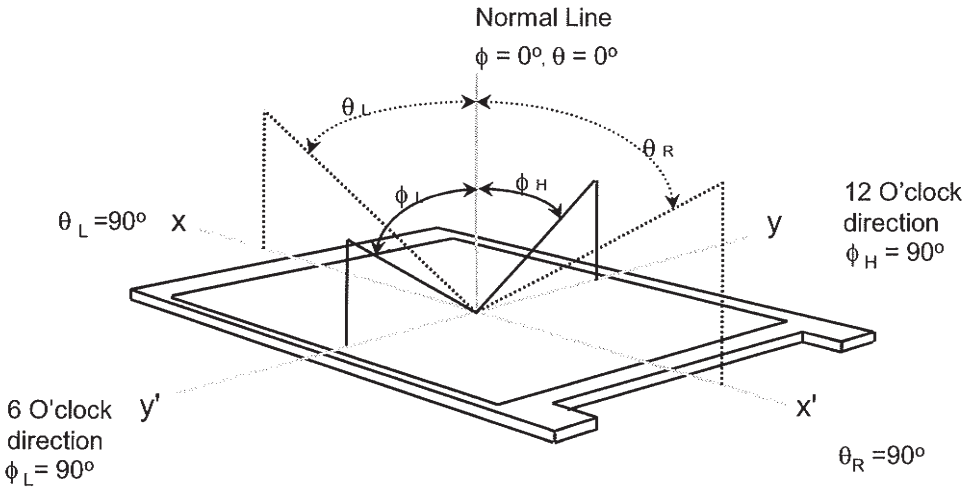
## 2. OPTICAL CHARACTERISTICS

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).
Measuring equipment : TOPCON BM-5A and PR-650

* Ta = 25 ± 2 °C, $V_{DD}$=3.3V, fv= 60Hz, $f_{DCLK}$ = 82.1MHz, $I_L$ = 6.0 mA

| Item | | Symbol | Condition | Min. | Typ. | Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio (5 Points) | | CR | Normal Viewing Angle $\phi = 0$ $\theta = 0$ | 400 | 500 | - | - | (1), (2), (5) |
| Response Time at Ta ( Rising + Falling ) | | $T_{RT}$ | | - | 16 | 20 | msec | (1), (3) |
| Average Luminance of White (5 Points) | | $Y_{L,AVE}$ | | 290 | 340 | - | cd/m$^2$ | $I_L$=6.0mA (1), (4) |
| Color Chromaticity ( CIE ) | Red | $R_X$ | | 0.630 | 0.650 | 0.670 | - | (1), (5) PR-650 |
| | | $R_Y$ | | 0.315 | 0.335 | 0.355 | | |
| | Green | $G_X$ | | 0.270 | 0.290 | 0.310 | | |
| | | $G_Y$ | | 0.585 | 0.605 | 0.625 | | |
| | Blue | $B_X$ | | 0.125 | 0.145 | 0.165 | | |
| | | $B_Y$ | | 0.055 | 0.075 | 0.095 | | |
| | White | $W_X$ | | 0.293 | 0.313 | 0.333 | | |
| | | $W_Y$ | | 0.309 | 0.329 | 0.349 | | |
| Viewing Angle | Hor. | $\theta_L$ | CR ≥ 10 | 55 | - | - | Degrees | (1), (5) BM-5A |
| | | $\theta_H$ | | 55 | - | - | | |
| | Ver. | $\phi_H$ | | 45 | - | - | | |
| | | $\phi_L$ | | 45 | - | - | | |
| Color Gamut | | | | - | 72 | - | % | |
| 13 Points White Variation | | $\delta_L$ | | - | - | 1.7 | - | (6) |

Note 1) Definition of Viewing Angle : Viewing angle range(10 ≤ C/R)

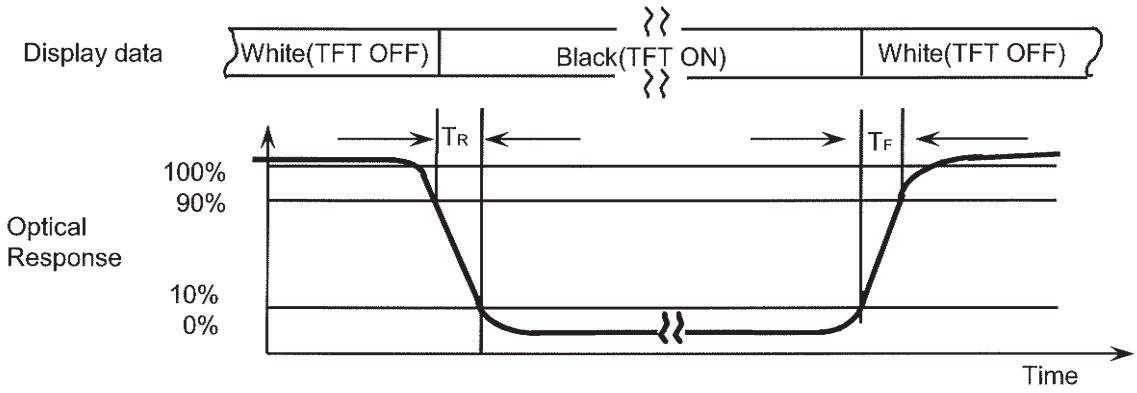



Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at 5 points(4, 5, 7, 9, 10)

$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

Points : ④ , ⑤ , ⑦ , ⑨ , ⑩ at the figure of Note (6).

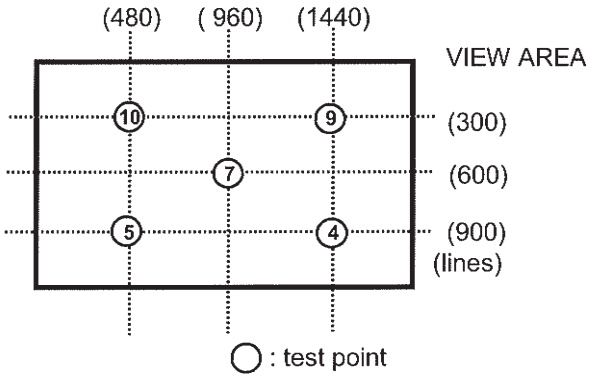
Note 3) Definition of Response time :



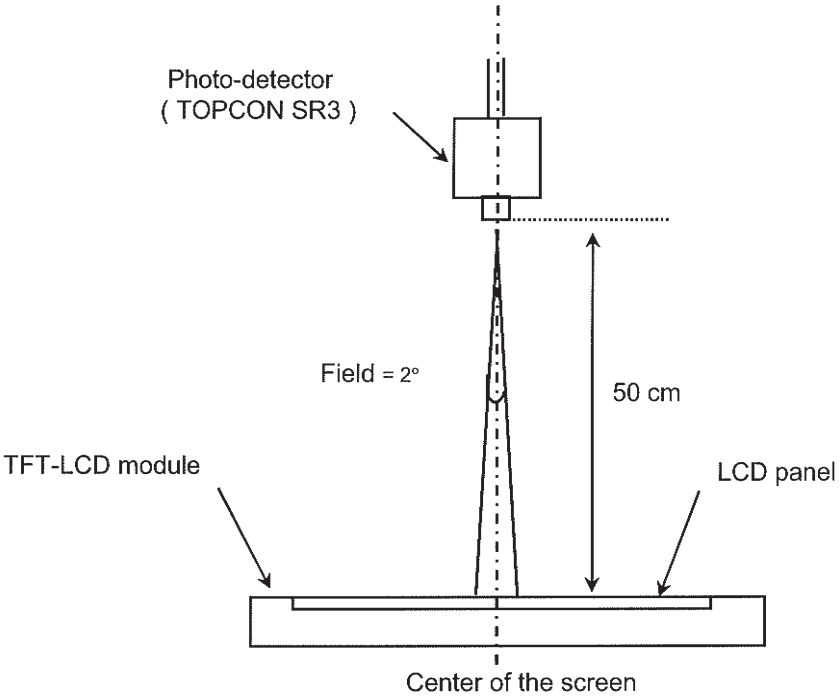

Note 4) Definition of Average Luminance of White : measure the luminance of white at 5 points.

Average Luminance of White ( $Y_{L,AVE}$ )

$$Y_{L,AVE} = \frac{Y_{L4} + Y_{L5} + Y_{L7} + Y_{L9} + Y_{L10}}{5}$$



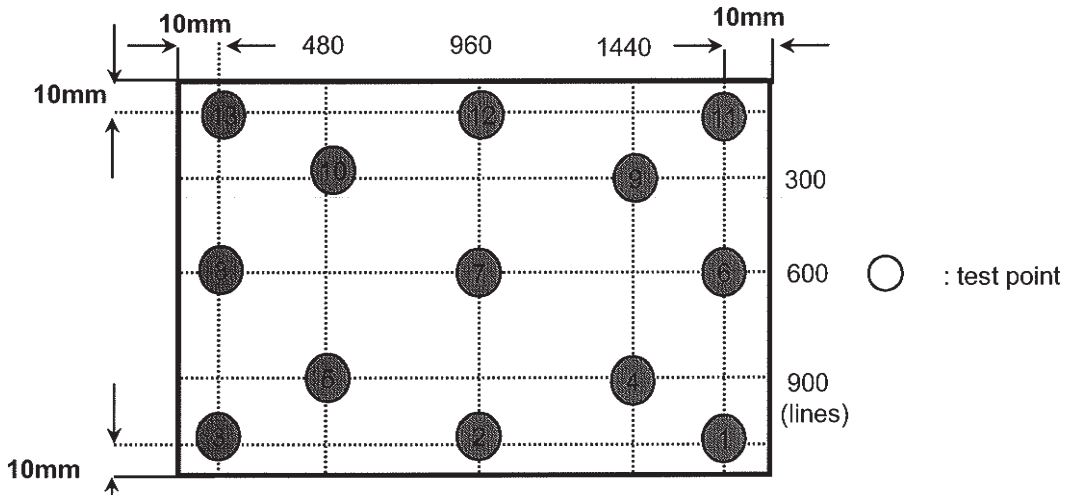
Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless,and dark room.
30 min after lighting the backlight. This should be measured in the center of screen.
Lamp current : 6.0mA ( Inverter : SIC-130T )
Environment condition : Ta = 25 ± 2 °C




[ Optical characteristics measurement setup ]

Note 6) Definition of 13 points white variation ($\delta_L$), CR variation( CVER ) [ ① ~ ⑬ ]

$$\delta_L = \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$



# 3. ELECTRICAL CHARACTERISTICS



## 3.1 TFT LCD MODULE

Ta= 25 ± 2°C

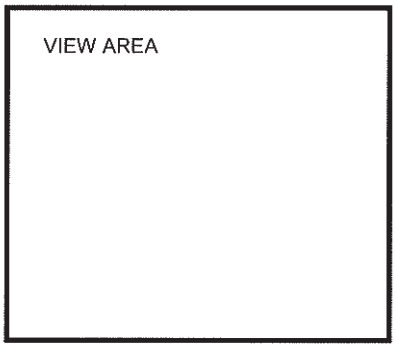
| Item | | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Voltage of Power Supply | | $V_{DD}$ | 3.0 | 3.3 | 3.6 | V | |
| Differential Input Voltage for LVDS Receiver Threshold | High | $V_{IH}$ | - | - | +100 | mV | $V_{CM}$ = +1.2V |
| | Low | $V_{IL}$ | -100 | - | - | mV | |
| Vsync Frequency | | fv | - | 60 | - | Hz | |
| Hsync Frequency | | $f_H$ | - | 73 | - | KHz | |
| Main Frequency | | $f_{DCLK}$ | - | 83.9 | - | MHz | 2CH |
| Rush Current | | $I_{RUSH}$ | - | - | 1.5 | A | (4) |
| Current of Power Supply | White | $I_{DD}$ | - | 500 | - | mA | (2),(3)*a |
| | Mosaic | | - | 550 | - | mA | (2),(3)*b |
| | V. stripe | | - | 720 | 820 | mA | (2),(3)*c |

Note (1) Display data pins and timing signal pins should be connected.( GND = 0V )

(2) fv = 60Hz, $f_{DCLK}$ = 82.1MHZ, $V_{DD}$ = 3.3V , DC Current.

(3) Power dissipation pattern

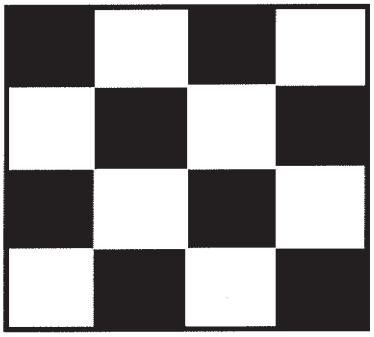
*a) White Pattern




Display Brightest Gray Level

Display Darkest Gray Level

*b) Mosaic Pattern



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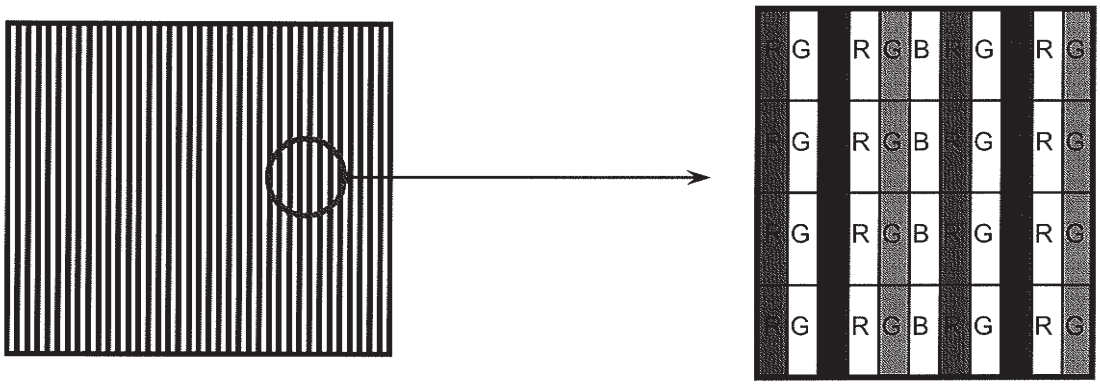
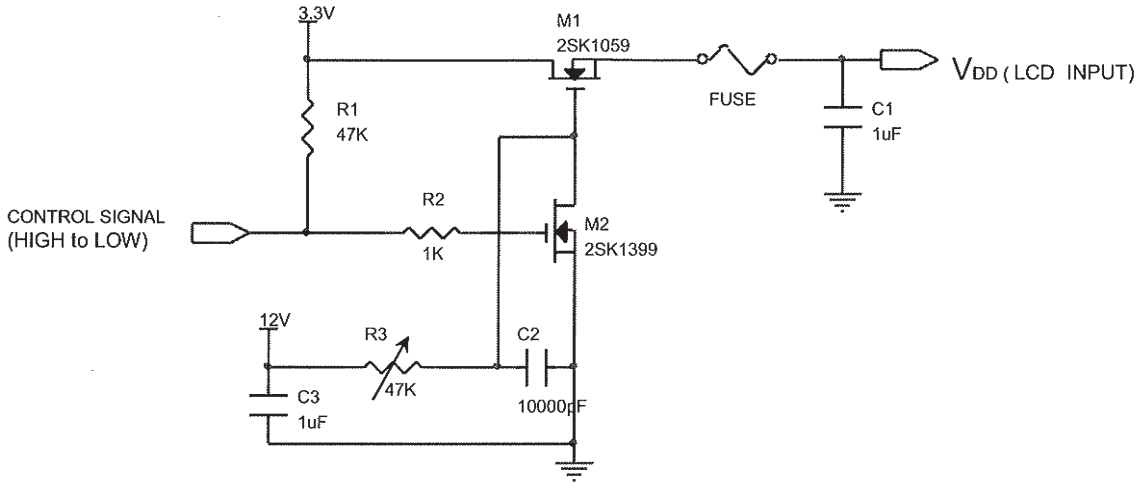
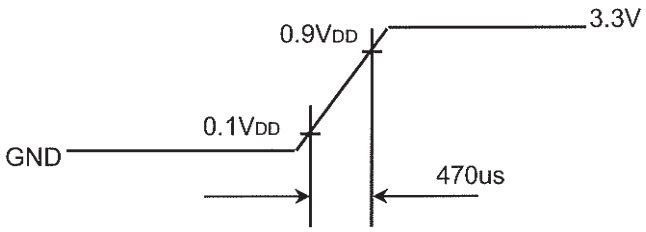
*c) 1dot Vertical stripe pattern




4) Rush current measurement condition




VDD rising time is 470us

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## 3.2 BACK-LIGHT UNIT

The backlight system is an edge-lighting type with dual CCFL ( Cold Cathode Fluorescent Lamp ).
The characteristics of a single lamp are shown in the following tables.

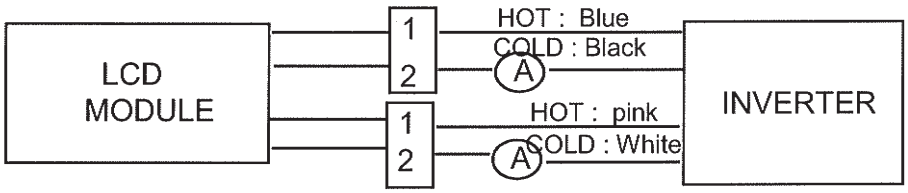
Ta= 25 ± 2 °C

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Lamp Current | $I_L$ | 4.0 | 6.0 | 7.0 | mArms | (1) |
| Lamp Voltage | $V_L$ | - | 750 | - | Vrms | $I_L$ = 6.0mA |
| Frequency | $f_L$ | 40 | 60 | 65 | KHz | (2) |
| Power Consumption | $P_L$ | - | 4.5 | | W | (3) $I_L$ = 6.0mA |
| Operating Life Time | Hr | 15,000 | - | - | Hour | (4) |
| Startup Voltage | $V_S$ | - | - | 1180 | Vrms | 25°C, (5) |
| | | | | 1415 | Vrms | 0°C, (5) |

Note) The waveform of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.

The performance of the backlight, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.
When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter(miss lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

Note (1) Lamp current is measured with a high frequency current meter as shown below.




(2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Refer to $I_L \times V_L$ to calculate.

(4) Life time (Hr) of a lamp can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and $I_L$ = 6.0 mArms until one of the following event occurs.

1. When the brightness becomes 50% or lower than the original.
2. When the Effective ignition length becomes 80% or lower than the original value.
   (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

(5) The inverter open voltage - this voltage should be measured after ballast capacitor- have to be larger than the lamp startup voltage, otherwise backlight may has blinking for a moment after turns on or not be turned on.
If an inverter has shutdown function it should keep its open voltage for longer than 1 second even if lamp connector open.

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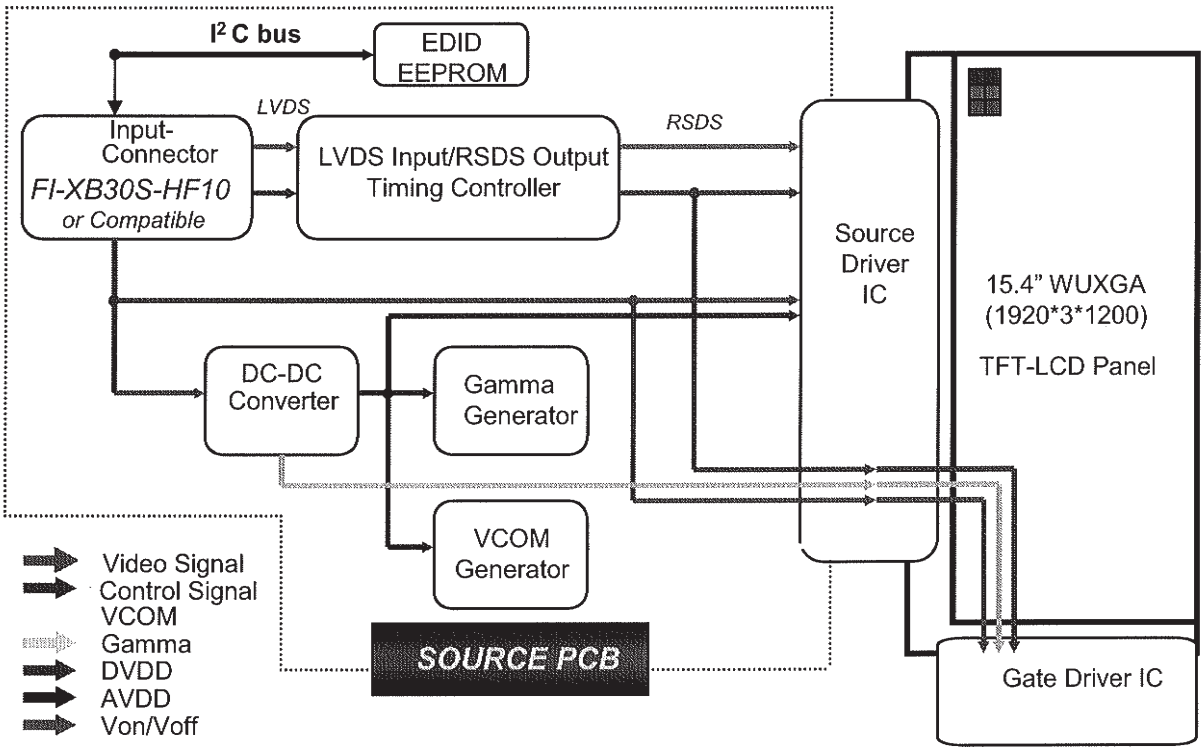
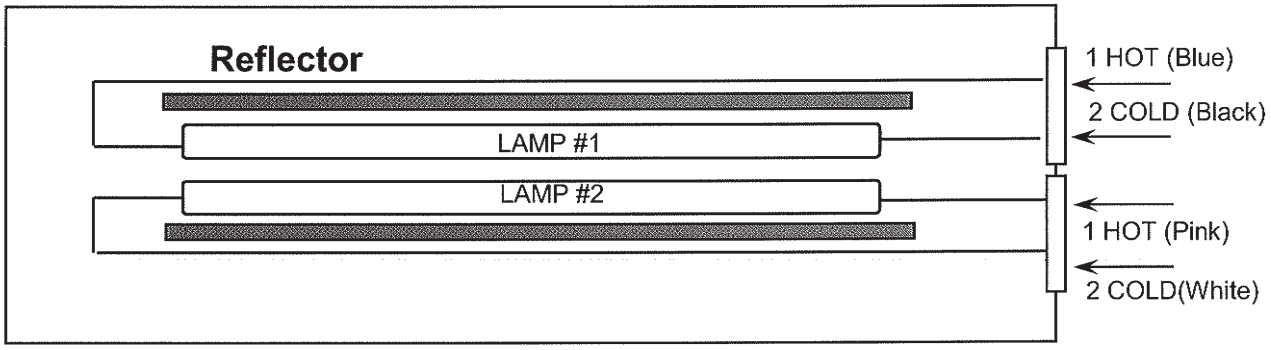
# 4. BLOCK DIAGRAM

## 4.1 TFT LCD Module




## 4.2 BACK-LIGHT UNIT

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## 5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : JAE FI-XB30SRL-HF11 or compatible )
Mating Connector : JAE FI-X30Sx or compatible)

| No. | Symbol | Function | Polarity | Remarks |
|---|---|---|---|---|
| 1 | VSS | Ground | | |
| 2 | VDD | POWER SUPPLY +3.3V | | |
| 3 | VDD | POWER SUPPLY +3.3V | | |
| 4 | VEEDID | DDC 3.3V Power | | |
| 5 | NC | No Connection | | |
| 6 | CLKEDID | DDC Clock | | |
| 7 | DATAEDID | DDC data | | |
| 8 | O_RxIN0- | LVDS Differential Data INPUT (Odd R0-R5,G0) | Negative | |
| 9 | O_RxIN0+ | LVDS Differential Data INPUT (Odd R0-R5,G0) | Positive | |
| 10 | GND | Ground | | |
| 11 | O_RxIN1- | LVDS Differential Data INPUT (Odd G1-G5,B0-B1) | Negative | |
| 12 | O_RxIN1+ | LVDS Differential Data INPUT (Odd G1-G5,B0-B1) | Positive | |
| 13 | GND | Ground | | |
| 14 | O_RxIN2- | LVDS Differential Data INPUT (Odd B2-B5,Sync,DE) | Negative | |
| 15 | O_RxIN2+ | LVDS Differential Data INPUT (Odd B2-B5,Sync,DE) | Positive | |
| 16 | GND | Ground | | |
| 17 | O_RxCLK- | LVDS Differential Data INPUT (Odd Clock) | Negative | |
| 18 | O_RxCLK+ | LVDS Differential Data INPUT (Odd Clock) | Positive | |
| 19 | GND | Ground | | |
| 20 | E_RxIN0- | LVDS Differential Data INPUT (Even R0-R5,G0 | Negative | |
| 21 | E_RxIN0+ | LVDS Differential Data INPUT (Even R0-R5,G0) | Positive | |
| 22 | GND | Ground | | |
| 23 | E_RxIN1- | LVDS Differential Data INPUT (Even G1-G5,B0-B1) | Negative | |
| 24 | E_RxIN1+ | LVDS Differential Data INPUT (Even G1-G5,B0-B1) | Positive | |
| 25 | GND | Ground | | |
| 26 | E_RxIN2- | LVDS Differential Data INPUT (Even B2-B5,Sync,DE) | Negative | |
| 27 | E_RxIN2+ | LVDS Differential Data INPUT (Even B2-B5,Sync,DE) | Positive | |
| 28 | GND | Ground | | |
| 29 | E_RxCLK- | LVDS Differential Data INPUT (Even Clock) | Negative | |
| 30 | E_RxCLK+ | LVDS Differential Data INPUT (Even Clock) | Positive | |

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## 5.2 LVDS Interface : Transmitter DS90CF363 or Compatible

LVDS for Odd pixel

| Pin No. | Name | RGB Signal | Pin No. | Name | RGB Signal |
|---|---|---|---|---|---|
| 44 | TxIN0 | RO0 | 12 | TxIN11 | GO5 |
| 45 | TxIN1 | RO1 | 13 | TxIN12 | BO0 |
| 47 | TxIN2 | RO2 | 15 | TxIN13 | BO1 |
| 48 | TxIN3 | RO3 | 16 | TxIN14 | BO2 |
| 1 | TxIN4 | RO4 | 18 | TxIN15 | BO3 |
| 3 | TxIN5 | RO5 | 19 | TxIN16 | BO4 |
| 4 | TxIN6 | GO0 | 20 | TxIN17 | BO5 |
| 6 | TxIN7 | GO1 | 22 | TxIN18 | Hsync |
| 7 | TxIN8 | GO2 | 23 | TxIN19 | Vsync |
| 9 | TxIN9 | GO3 | 25 | TxIN20 | DE |
| 10 | TxIN10 | GO4 | 26 | TxCLK IN | Clock |

LVDS for Even pixel

| Pin No. | Name | RGB Signal | Pin No. | Name | RGB Signal |
|---|---|---|---|---|---|
| 44 | TxIN0 | RE0 | 12 | TxIN11 | GE5 |
| 45 | TxIN1 | RE1 | 13 | TxIN12 | BE0 |
| 47 | TxIN2 | RE2 | 15 | TxIN13 | BE1 |
| 48 | TxIN3 | RE3 | 16 | TxIN14 | BE2 |
| 1 | TxIN4 | RE4 | 18 | TxIN15 | BE3 |
| 3 | TxIN5 | RE5 | 19 | TxIN16 | BE4 |
| 4 | TxIN6 | GE0 | 20 | TxIN17 | BE5 |
| 6 | TxIN7 | GE1 | 22 | TxIN18 | N/C |
| 7 | TxIN8 | GE2 | 23 | TxIN19 | N/C |
| 9 | TxIN9 | GE3 | 25 | TxIN20 | N/C |
| 10 | TxIN10 | GE4 | 26 | TxCLK IN | Clock |

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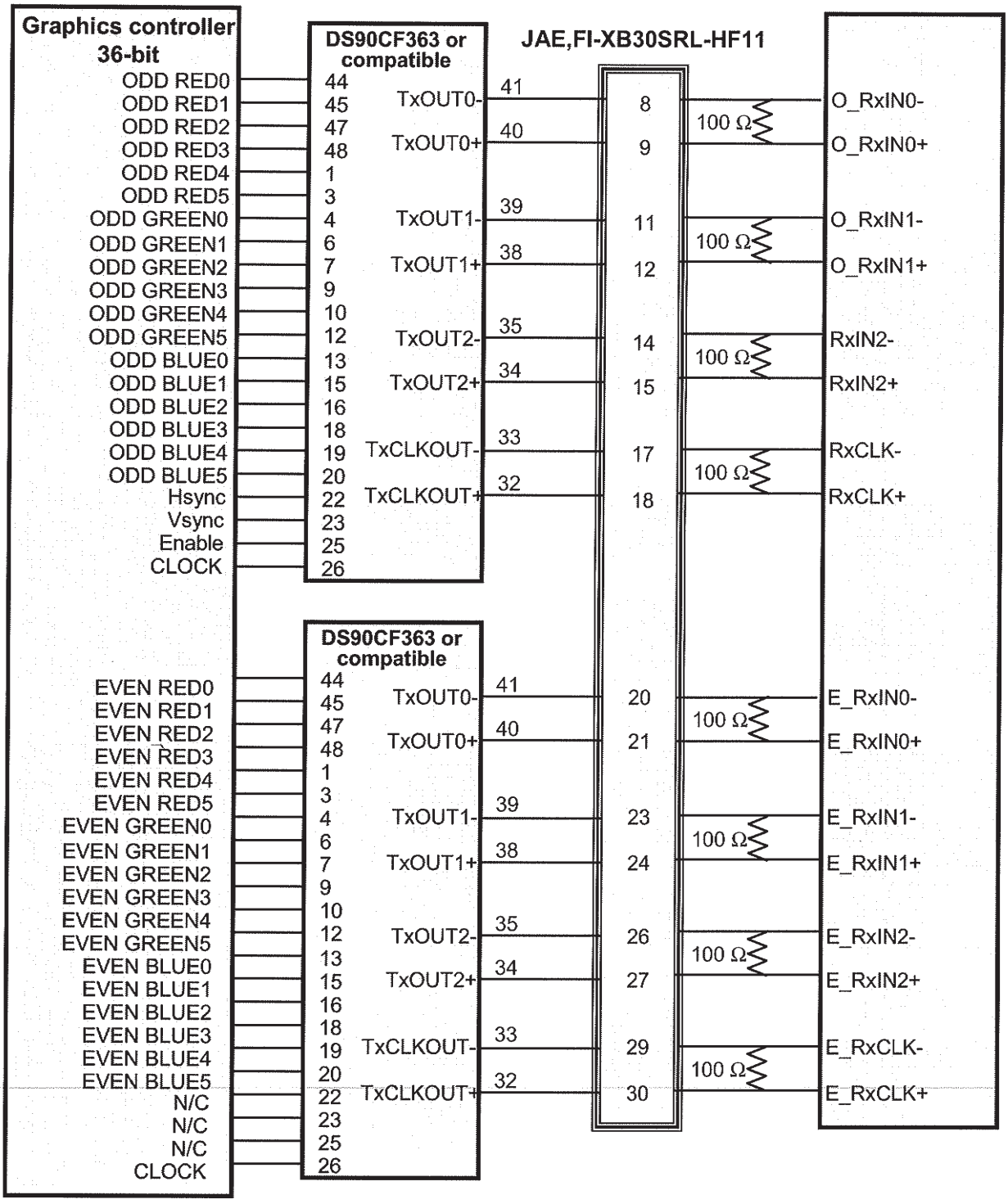
## LVDS Interface




Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

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## 5.3 BACK LIGHT UNIT

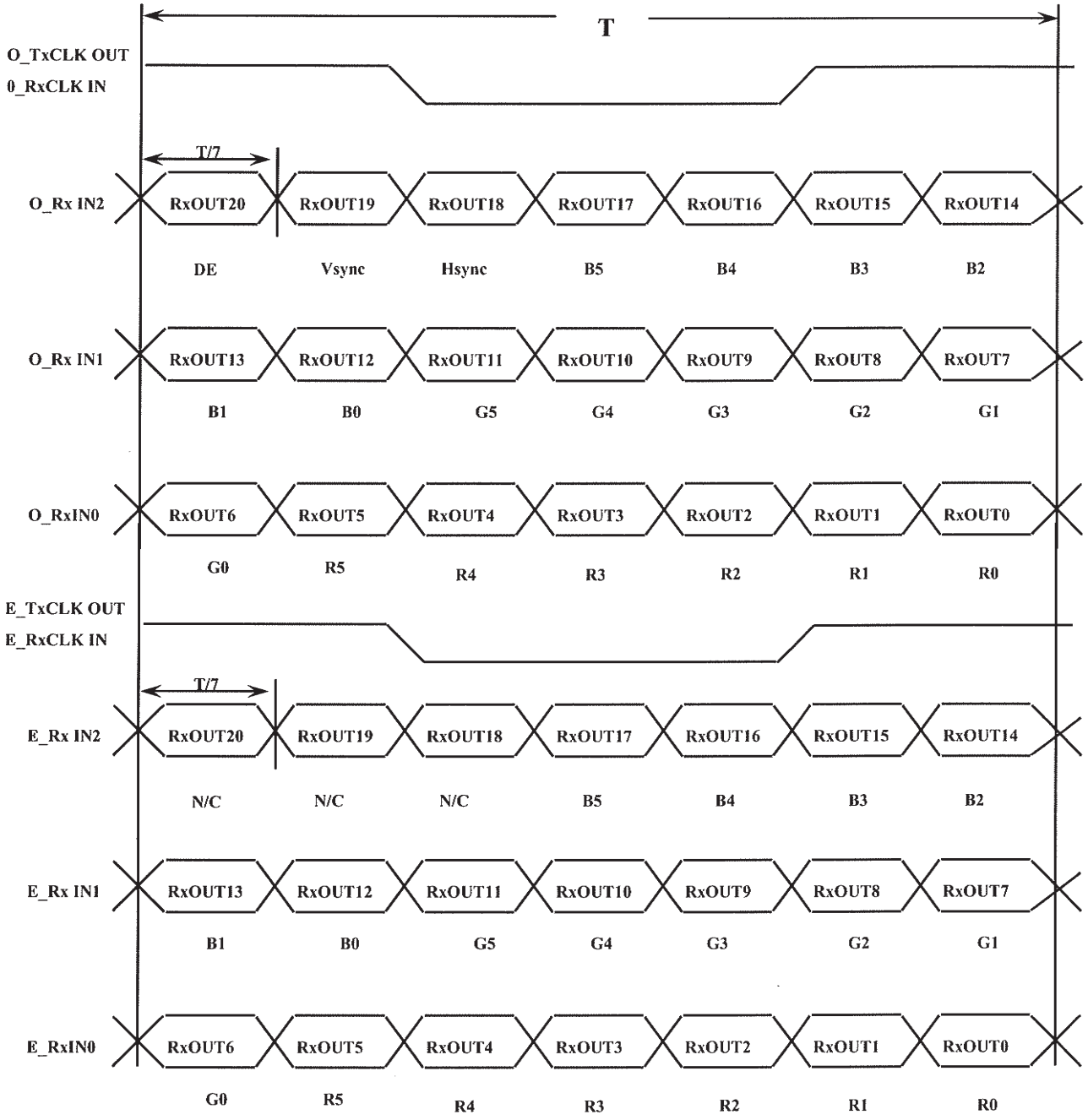


Connector : JST BHSR - 02VS -1
Mating Connector : SM02B-BHSS-1(JST)

| Pin NO. | Symbol | Color | Function |
|---|---|---|---|
| 1 | HOT | Pink / Blue | High Voltage |
| 2 | COLD | White / Black | Low Voltage |

## 5.4 Timing Diagrams of LVDS For Transmission

LVDS Receiver : Integrated T-CON

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## 5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color

| Color | Display | Data Signal | | | | | | | | | | | | | | | | | | Gray Scale Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red | | | | | | Green | | | | | | Blue | | | | | | |
| | | R0 | R1 | R2 | R3 | R4 | R5 | G0 | G1 | G2 | G3 | G4 | G5 | B0 | B1 | B2 | B3 | 45 | B5 | |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| Gray Scale Of Red | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R0 |
| | Dark | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R1 |
| | ↑ | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R2 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | R3~R60 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R61 |
| | Light | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R62 |
| | Red | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R63 |
| Gray Scale Of Green | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G0 |
| | Dark | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G1 |
| | ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G2 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | G3~G60 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G61 |
| | Light | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G62 |
| | Green | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G63 |
| Gray Scale Of Blue | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B0 |
| | Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | B1 |
| | ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | B2 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | B3~B60 |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | B61 |
| | Light | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | B62 |
| | Blue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | B63 |

Note 1) Definition of gray :
Rn: Red gray, Gn: Green gray, Bn: Blue gray (n=gray level)
Note 2)Input signal: 0 =Low level voltage, 1=High level voltage

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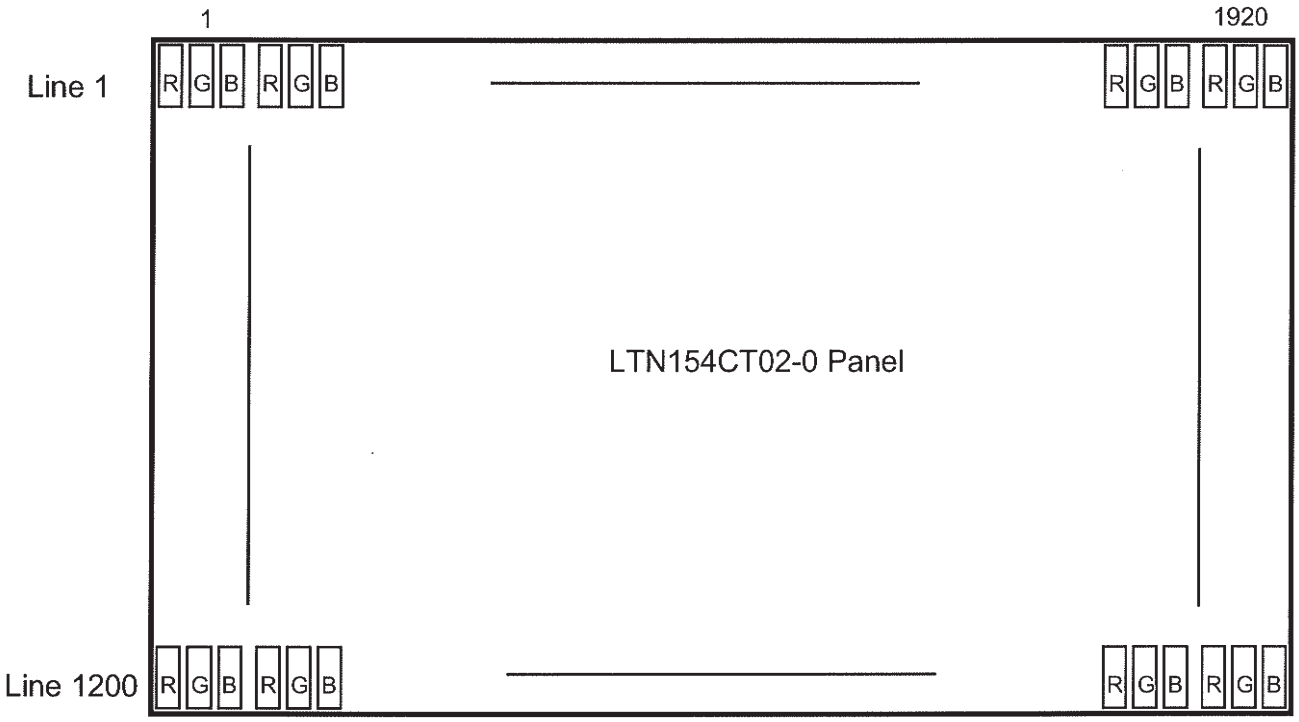
## 5.6 Pixel Format in the display



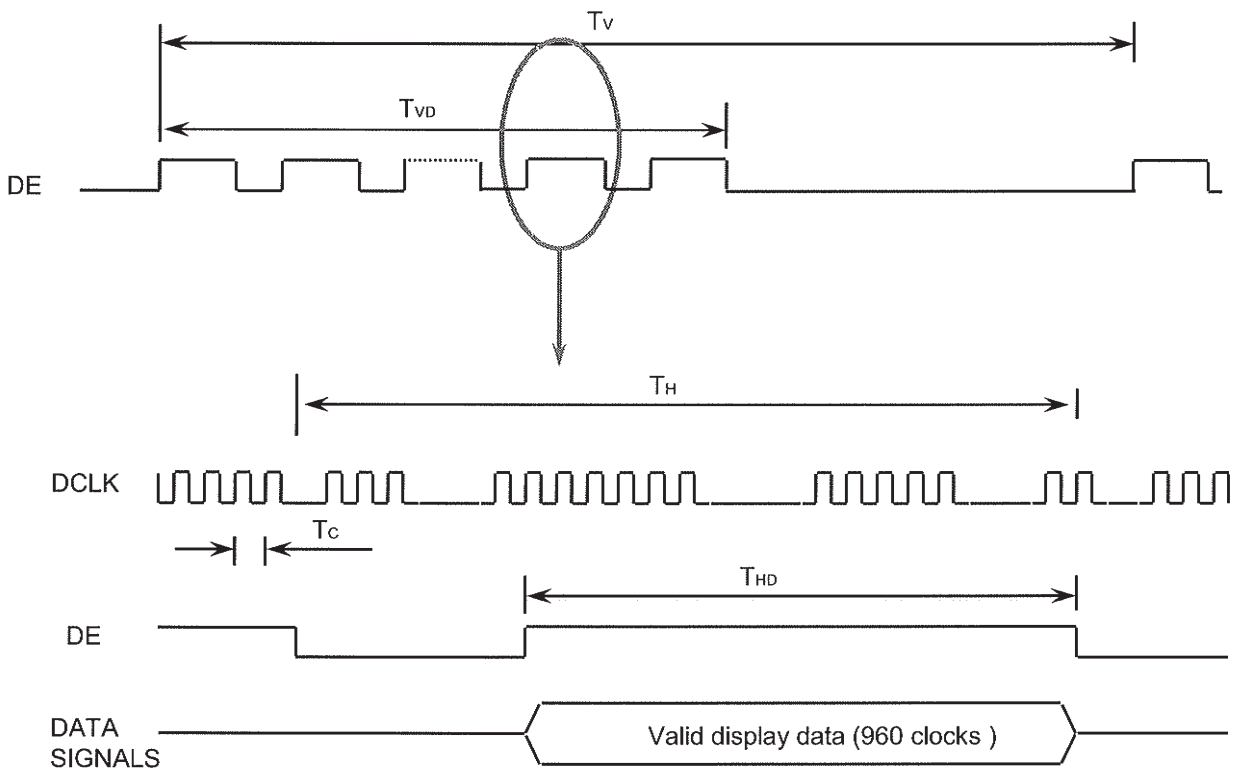
Approval

## 6. INTERFACE TIMING

### 6.1 Timing Parameters

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Frame Frequency | Cycle | TV | 1204 | 1250 | 1400 | Lines | |
| Vertical Active Display Term | Display Period | TVD | - | 1200 | - | Lines | |
| One Line Scanning Time | Cycle | TH | 1030 | 1080 | 1170 | Clocks | |
| Horizontal Active Display Term | Display Period | THD | - | 960 | - | Clocks | |

### 6.2 Timing diagrams of interface signal

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6.3 Power ON/OFF Sequence

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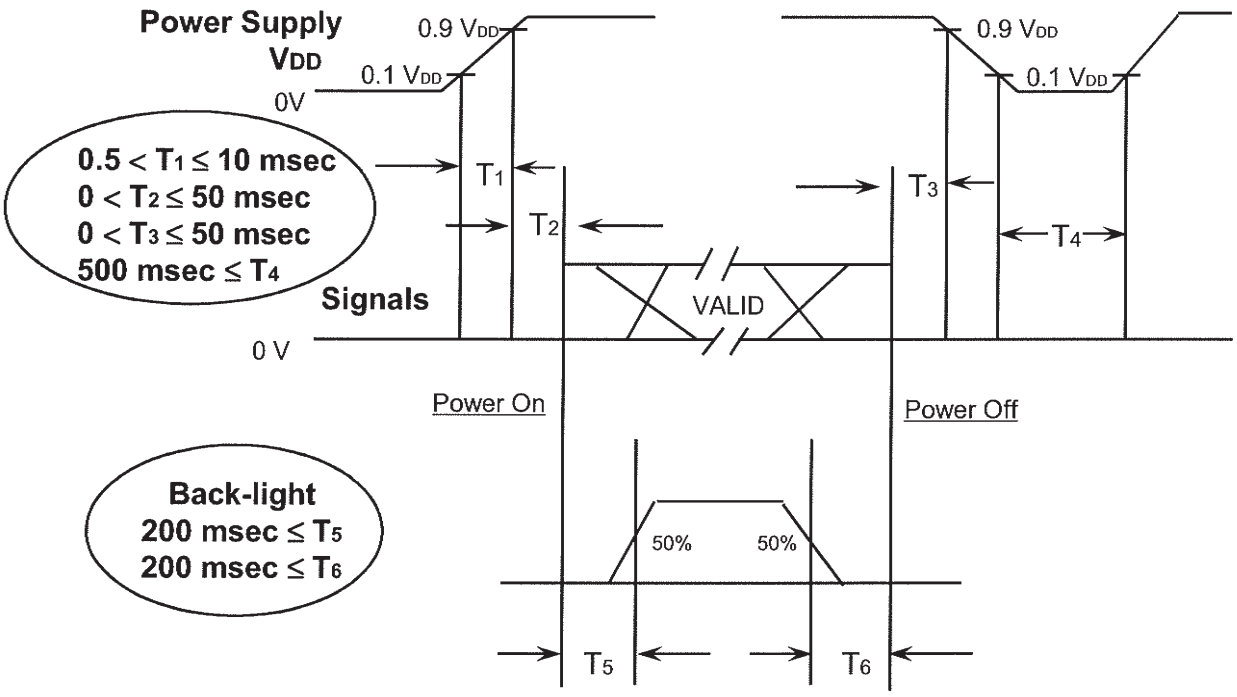
: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.




Power ON/OFF Sequence

T1 : Vdd rising time from 10% to 90%
T2 : The time from Vdd to valid data at power ON.
T3 : The time from valid data off to Vdd off at power Off.
T4 : Vdd off time for Windows restart
T5 : The time from valid data to B/L enable at power ON.
T6 : The time from valid data off to B/L disable at power Off.

NOTE.

(1) The supply voltage of the external system for the module input should be the same as the definition of VDD.

(2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become white.

(3) In case of VDD = off level, please keep the level of input signals on the low or keep a high impedance.

(4) T4 should be measured after the module has been fully discharged between power off and on period.

(5) Interface signal shall not be kept at high impedance when the power is on.

## 7. Mechanical Outline Dimension

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[ Refer to the next page ]

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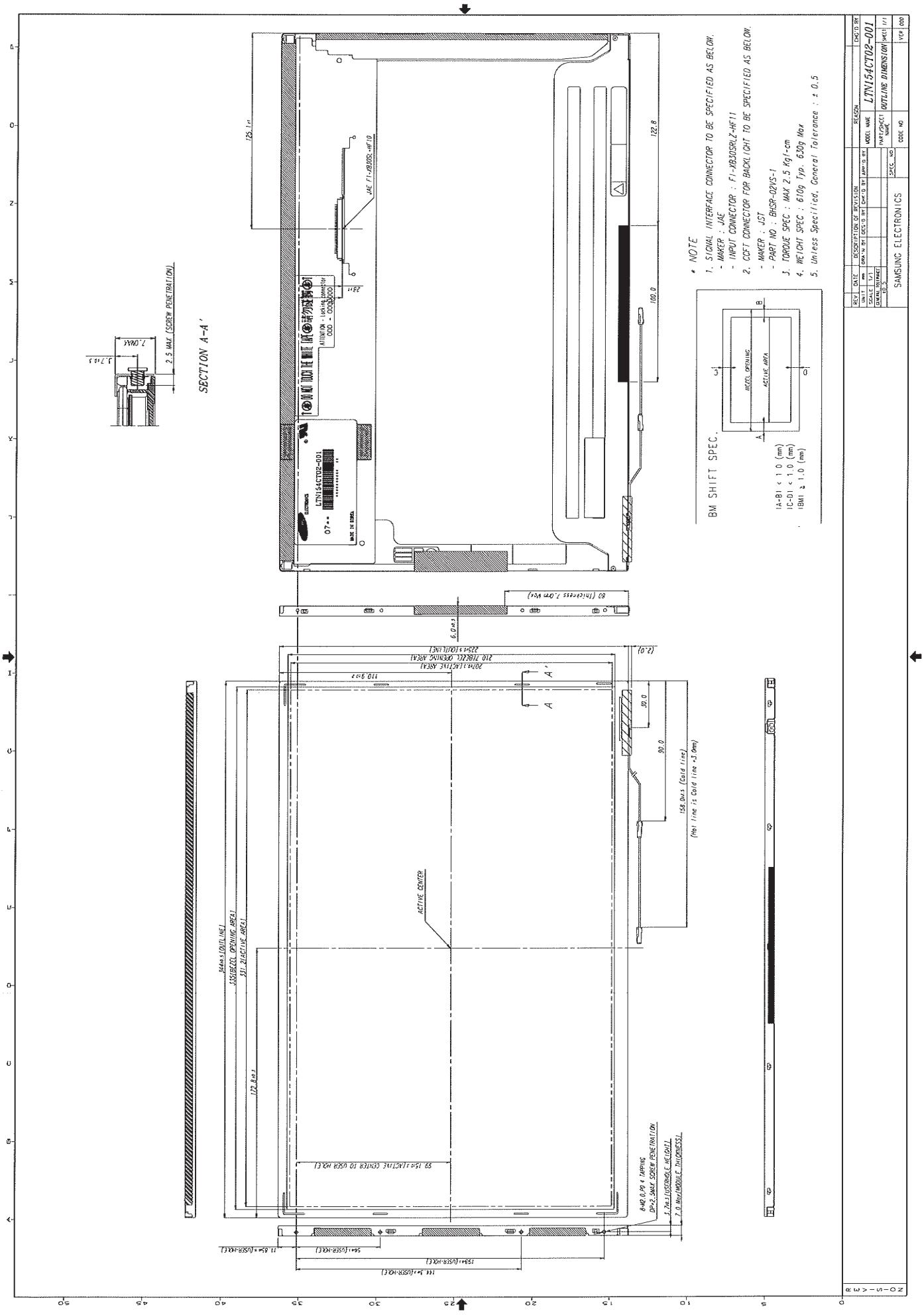


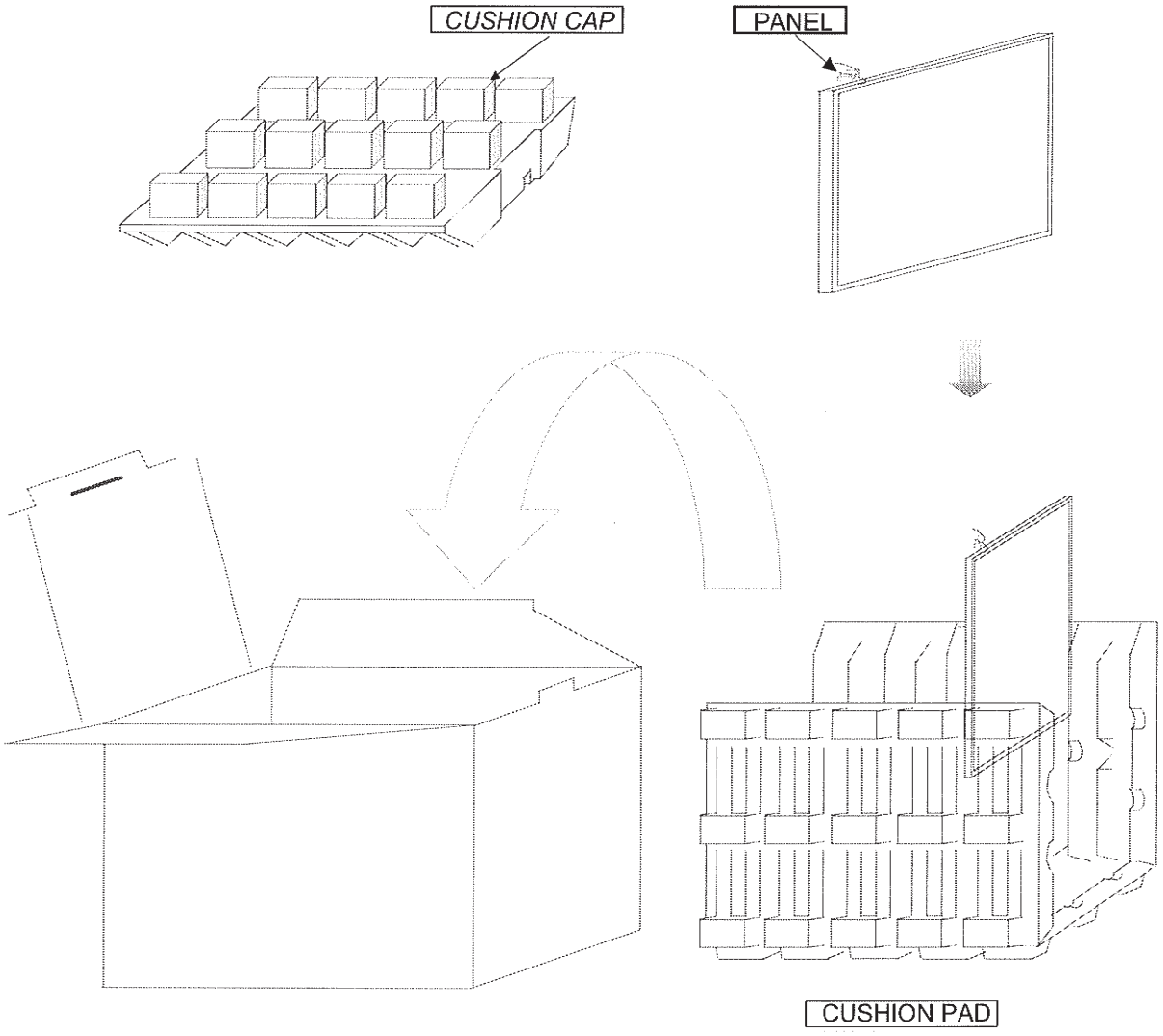
## 8. PACKING

Approval

1. CARTON(Internal Package)

(1) Packing Form
Corrugated Cardboard box and Corrupad form as shock absorber

(2) Packing Method




Note 1)Total Weight : Approximately 10 kg
2) Acceptance number of piling : 10 sets
3) Carton size : 376(W) X 326(D) X 404(H)

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(3)Packing Material

| No | Part name | Quantity |
|---|---|---|
| 1 | Static electric protective sack | 10 pcs |
| 2 | Packing case (Inner box) included shock absorber | 1 set |
| 3 | Pictorial marking | 2 pcs |
| 4 | Carton | 1 set |

## 9. MARKINGS & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

(1) Parts number : LTNXXXXX-XXX

- Serial no.
- Interface
- Generation
- Resolution
- Size

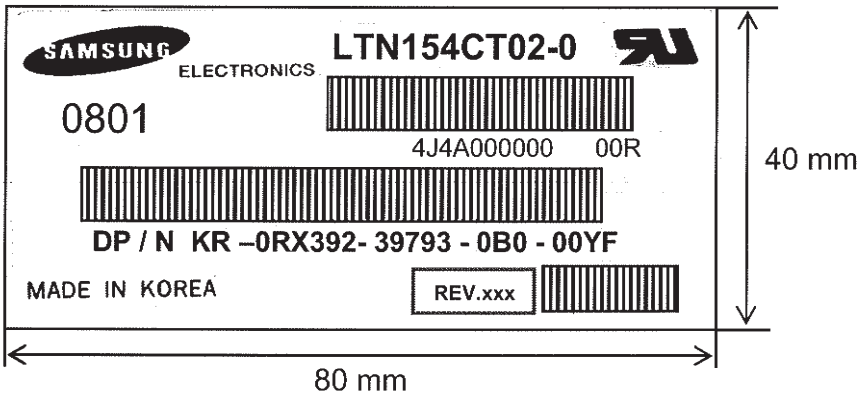
(2) Revision : Three letters

(3) Lot number : X Y 4 A XXX XX X

- Cell Position No.(In the one Glass)
- Glass No.(In the one Lot)
- Lot No.(Glass)
- Month
- Year(Note 1)
- Product Code
- Line

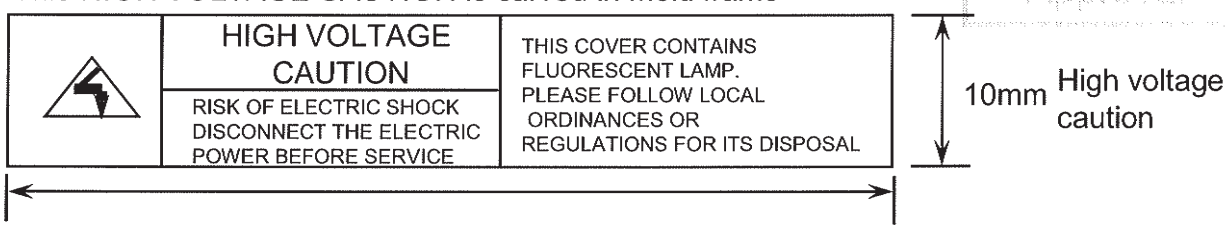
NOTE 1). This code indicating year is omitted in the products of KIHENG site.

(4) Nameplate Indication (Following example is only for reference)




Parts name : LTN154CT02-0
Lot number : 4J4A000000
Inspected work week : 0801
DP/N : Dell Part Number ("**0RX392**" is for 154CT02-0)
REV.xxx : Product Revision Code (Refer to the next page)

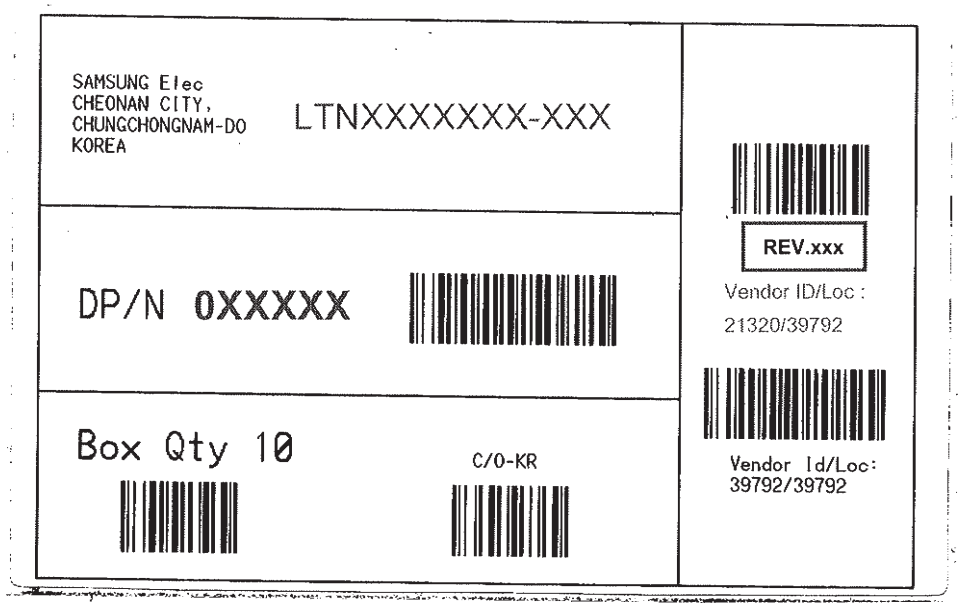
This HIGH VOLTAGE CAUTION is carved in mold frame




※ Panel revision code scheme (Refer to the Red box on the label)

| Build Name(s) | Revision Code(s) |
|---|---|
| SST (WS) | X00, X01, X02, … X09 |
| PT (ES) | X10, X11, X12, … X19 |
| ST (CS) | X20, X21, X23, … X29 |
| XB (MP) | A00, A01, A02, … A99 |

(6) Packing small box attach ( Following example is only for reference )




0XXXXX : DELL P/N

(7) Packing box Marking : Samsung TFT-LCD Brand Name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## 10. GENERAL PRECAUTIONS

Approval

1. Handling

(a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.

(b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and CCFT backlight.

(c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.

(d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.

(e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(f) The desirable cleaners are water, IPA(Isoprophyl Alcohol) or Hexane.
Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(h) Protect the module from static , it may cause damage to the C-MOS Gate Array IC.

(i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(j) Do not disassemble the module.

(k) Do not pull or fold the lamp wire.

(l) Do not adjust the variable resistor which is located on the back side.

(m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(n) Pins of I/F connector shall not be touched directly with bare hands.

## 2. STORAGE

(a) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%.

(b) Do not store the TFT-LCD module in direct sunlight.

(c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

## 3. OPERATION

(a) Do not connect,disconnect the module in the " Power On" condition.

(b) Power supply should always be turned on/off by following item 6.3 " Power on/off sequence ".

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

(d) The cable between the backlight connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the backlight and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

(e) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, SEC is not to be held reliable for the defective operations. It is strongly recommended to contact SEC to find out fitness for a particular purpose.

## 4. OTHERS

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. ( the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.

(d) If the module displays the same pattern continuously for a long period of time,it can be the situation when the image "sticks" to the screen.

(e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.

Approval

| | Byte (hex) | Field Name and Comments | Value (hex) | Value (binary) |
|---|---|---|---|---|
| Header | 0 | Header | 00 | 00000000 |
| | 1 | Header | FF | 11111111 |
| | 2 | Header | FF | 11111111 |
| | 3 | Header | FF | 11111111 |
| | 4 | Header | FF | 11111111 |
| | 5 | Header | FF | 11111111 |
| | 6 | Header | FF | 11111111 |
| | 7 | Header | 00 | 00000000 |
| Vendor / Product EDID Version | 8 | EISA manufacture code = 3 Character ID | 4C | 01001100 |
| | 9 | EISA manufacture code (Compressed ASCII) | A3 | 10100011 |
| | 0A | Panel Supplier Reserved – Product Code | 43 | 01000011 |
| | 0B | Panel Supplier Reserved – Product Code | 54 | 01010100 |
| | 0C | LCD module Serial No - Preferred but Optional ("0" if not used) | 00 | 00000000 |
| | 0D | LCD module Serial No - Preferred but Optional ("0" if not used) | 00 | 00000000 |
| | 0E | LCD module Serial No - Preferred but Optional ("0" if not used) | 00 | 00000000 |
| | 0F | LCD module Serial No - Preferred but Optional ("0" if not used) | 00 | 00000000 |
| | 10 | Week of manufacture | 00 | 00000000 |
| | 11 | Year of manufacture | 12 | 00010010 |
| | 12 | EDID structure version # = 1 | 01 | 00000001 |
| | 13 | EDID revision # = 3 | 03 | 00000011 |
| Display Parameters | 14 | Video I/P definition = Digital I/P | 90 | 10010000 |
| | 15 | Max H image size = (Rounded to cm) | 21 | 00100001 |
| | 16 | Max V image size = (Rounded to cm) | 15 | 00010101 |
| | 17 | Display gamma = (gamma ×100)-100 = Example: ( 2.2 × 100 ) – 100 = 120 | 78 | 01111000 |
| | 18 | Feature support ( no DPMS, Active off, RGB, timing BLK 1) | 0A | 00001010 |
| Panel Color Coordinates | 19 | Red/Green Low bit (RxRy/GxGy) | 87 | 10000111 |
| | 1A | Blue/White Low bit (BxBy/WxWy) | F5 | 11110101 |
| | 1B | Red X Rx = 0.xxx | 94 | 10010100 |
| | 1C | Red Y Ry = 0.xxx | 57 | 01010111 |
| | 1D | Green X Gx = 0.xxx | 4F | 01001111 |
| | 1E | Green Y Gy = 0.xxx | 8C | 10001100 |
| | 1F | Blue X Bx = 0.xxx | 27 | 00100111 |
| | 20 | Blue Y By = 0.xxx | 27 | 00100111 |
| | 21 | White X Wx = 0.xxx | 50 | 01010000 |
| | 22 | White Y Wy = 0.xxx | 54 | 01010100 |
| Established Timings | 23 | Established timings 1 (00h if not used) | 00 | 00000000 |
| | 24 | Established timings 2 (00h if not used) | 00 | 00000000 |
| | 25 | Manufacturer's timings (00h if not used) | 00 | 00000000 |

Approval

| | | | | |
|---|---|---|---|---|
| Standard Timing ID | 26 | Standard timing ID1 (01h if not used) | 01 | 00000001 |
| | 27 | Standard timing ID1 (01h if not used) | 01 | 00000001 |
| | 28 | Standard timing ID2 (01h if not used) | 01 | 00000001 |
| | 29 | Standard timing ID2 (01h if not used) | 01 | 00000001 |
| | 2A | Standard timing ID3 (01h if not used) | 01 | 00000001 |
| | 2B | Standard timing ID3 (01h if not used) | 01 | 00000001 |
| | 2C | Standard timing ID4 (01h if not used) | 01 | 00000001 |
| | 2D | Standard timing ID4 (01h if not used) | 01 | 00000001 |
| | 2E | Standard timing ID5 (01h if not used) | 01 | 00000001 |
| | 2F | Standard timing ID5 (01h if not used) | 01 | 00000001 |
| | 30 | Standard timing ID6 (01h if not used) | 01 | 00000001 |
| | 31 | Standard timing ID6 (01h if not used) | 01 | 00000001 |
| | 32 | Standard timing ID7 (01h if not used) | 01 | 00000001 |
| | 33 | Standard timing ID7 (01h if not used) | 01 | 00000001 |
| | 34 | Standard timing ID8 (01h if not used) | 01 | 00000001 |
| | 35 | Standard timing ID8 (01h if not used) | 01 | 00000001 |
| Timing Descripter #1 | 36 | Pixel Clock/10,000 (LSB) | 24 | 00100100 |
| | 37 | Pixel Clock/10,000 (MSB) | 40 | 01000000 |
| | 38 | Horizontal Active = xxxx pixels (lower 8 bits) | 80 | 10000000 |
| | 39 | Horizontal Blanking (Thbp) = xxxx pixels (lower 8 bits) | 28 | 00101000 |
| | 3A | Horizontal Active/Horizontal blanking (Thbp) (upper4:4 bits) | 71 | 01110001 |
| | 3B | Vertical Active = xxxx lines | B0 | 10110000 |
| | 3C | Vertical Blanking (Tvbp) = xxxx lines (DE Blanking typ. for DE only panels) | 23 | 00100011 |
| | 3D | Vertical Active : Vertical Blanking (Tvbp) (upper4:4 bits) | 40 | 01000000 |
| | 3E | Horizontal Sync, Offset (Thfp) = xxxx pixels | 64 | 01100100 |
| | 3F | Horizontal Sync, Pulse Width = xxxx pixels | 20 | 00100000 |
| | 40 | Vertical Sync, Offset (Tvfp) = xx lines Sync Width = xx lines | 26 | 00100110 |
| | 41 | Horizontal Vertical Sync Offset/Width upper 2 bits | 00 | 00000000 |
| | 42 | Horizontal Image Size =xxx mm | 4B | 01001011 |
| | 43 | Vertical image Size = xxx mm | CF | 11001111 |
| | 44 | Horizontal Image Size / Vertical image size | 10 | 00010000 |
| | 45 | Horizontal Border = 0 (Zero for Notebook LCD) | 00 | 00000000 |
| | 46 | Vertical Border = 0 (Zero for Notebook LCD) | 00 | 00000000 |
| | 47 | Bit[7] 0: Non-interlace, 1: Interlace<br>Bit[6:5] 00: Normal display, no strero, XX: See table xx for definition<br>Bit[4:3] 00: Analog composite, 01: Bipolar analog composite, 10: Digital composite, 11: Digital separate<br>Bit[2:1] :The interpretation of bits 2 and 1 is dependent on the decode of bits 4 and 3 - see Table 3.18.<br>Bit[0] :See Table VESA EDID spec for definition<br><br>Referenced Default = 1Ah | 1A | 00011010 |
| Timing Descripter #2 | 48 | Pixel Clock/10,000 (LSB) | C3 | 11000011 |
| | 49 | Pixel Clock/10,000 (MSB) | 2A | 00101010 |
| | 4A | Horizontal Active = xxxx pixels (lower 8 bits) | 80 | 10000000 |
| | 4B | Horizontal Blanking (Thbp) = xxxx pixels (lower 8 bits) | 28 | 00101000 |
| | 4C | Horizontal Active/Horizontal blanking (Thbp) (upper4:4 bits) | 71 | 01110001 |
| | 4D | Vertical Active = xxxx lines | B0 | 10110000 |
| | 4E | Vertical Blanking (Tvbp) = xxxx lines (DE Blanking typ. for DE only panels) | 23 | 00100011 |
| | 4F | Vertical Active : Vertical Blanking (Tvbp) (upper4:4 bits) | 40 | 01000000 |
| | 50 | Horizontal Sync, Offset (Thfp) = xxxx pixels | 64 | 01100100 |
| | 51 | Horizontal Sync, Pulse Width = xxxx pixels | 20 | 00100000 |
| | 52 | Vertical Sync, Offset (Tvfp) = xx lines Sync Width = xx lines | 26 | 00100110 |
| | 53 | Horizontal Vertical Sync Offset/Width upper 2 bits | 00 | 00000000 |
| | 54 | Horizontal Image Size =xxx mm | 4B | 01001011 |
| | 55 | Vertical image Size = xxx mm | CF | 11001111 |
| | 56 | Horizontal Image Size / Vertical image size | 10 | 00010000 |
| | 57 | Horizontal Border = 0 (Zero for Notebook LCD) | 00 | 00000000 |
| | 58 | Vertical Border = 0 (Zero for Notebook LCD) | 00 | 00000000 |
| | 59 | Bit[7] 0: Non-interlace, 1: Interlace<br>Bit[6:5] 00: Normal display, no strero, XX: See table xx for definition<br>Bit[4:3] 00: Analog composite, 01: Bipolar analog composite, 10: Digital composite, 11: Digital separate<br>Bit[2:1] :The interpretation of bits 2 and 1 is dependent on the decode of bits 4 and 3 - see Table 3.18.<br>Bit[0] :See Table VESA EDID spec for definition<br><br>Referenced Default = 1Ah | 1A | 00011010 |

| | | | | |
|---|---|---|---|---|
| Timing Descripter #3 Dell specific information | 5A | Flag | 00 | 00000000 |
| | 5B | Flag | 00 | 00000000 |
| | 5C | Flag | 00 | 00000000 |
| | 5D | Data Type Tag: Alphanumeric Data String (ASCII) | FE | 11111110 |
| | 5E | Flag | 00 | 00000000 |
| | 5F | Dell P/N 1st Character | 52 | 01010010 |
| | 60 | Dell P/N 2nd Character | 58 | 01011000 |
| | 61 | Dell P/N 3rd Character | 33 | 00110011 |
| | 62 | Dell P/N 4th Character | 39 | 00111001 |
| | 63 | Dell P/N 5th Character | 32 | 00110010 |
| | 64 | LCD Supplier EEDID Revision #<br>Bit[7] : 0=X, 1=A<br>Bit[6:0] : 00, 01, 02… for SST<br>10, 11, 12… for PT<br>20, 21, 22… for ST<br>00, 01, 02… for X-Build (if Bit[7]=1) | 80 | 10000000 |
| | 65 | Manufacturer P/N | 31 | 00110001 |
| | 66 | Manufacturer P/N | 35 | 00110101 |
| | 67 | Manufacturer P/N | 34 | 00110100 |
| | 68 | Manufacturer P/N | 43 | 01000011 |
| | 69 | Manufacturer P/N | 54 | 01010100 |
| | 6A | Manufacturer P/N | 0A | 00001010 |
| | 6B | Manufacturer P/N (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| Timing Descripter #4 | 6C | Flag | 00 | 00000000 |
| | 6D | Flag | 00 | 00000000 |
| | 6E | Flag | 00 | 00000000 |
| | 6F | Data Type Tag: Manufacturer Specified Data 00 | FE | 11111110 |
| | 70 | Flag | 00 | 00000000 |
| | 71 | SMBUS Value = XX nits | 00 | 00000000 |
| | 72 | SMBUS Value = XX nits | 00 | 00000000 |
| | 73 | SMBUS Value = XX nits | 00 | 00000000 |
| | 74 | SMBUS Value = XX nits | 00 | 00000000 |
| | 75 | SMBUS Value = XX nits | 00 | 00000000 |
| | 76 | SMBUS Value = XXX nits | 00 | 00000000 |
| | 77 | SMBUS Value = XXX nits | 00 | 00000000 |
| | 78 | SMBUS Value = max nits (Typically = 00h, XXX nits) | 00 | 00000000 |
| | 79 | Bit[7:3] Reserved<br>Bit[2] 0: No RTC support, 1: RTC support<br>Bit[1:0] 00: reserved, 01: single LVDS, 10: dual LVDS, 11: reserved<br>01h single channel LVDS, no RTC support<br>02h dual channel LVDS, no RTC support<br>05h single channel LVDS, with RTC support<br>06h dual channel LVDS, with RTC support | 02 | 00000010 |
| | 7A | BIST Enable: Yes = '01' No = '00' | 01 | 00000001 |
| | 7B | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 0A | 00001010 |
| | 7C | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| | 7D | (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h) | 20 | 00100000 |
| Checksum | 7E | Extension flag (# of optional 128 EDID extension blocks to follow, Typ = 0) | 00 | 00000000 |
| | 7F | Checksum (The 1-byte sum of all 128 bytes in this EDID block shall = 0) | ED | 11101101 |